Summary and Next Steps
Renewable Energy Modeling Series
Policy Makers' Roundtable
October 2, 2002

Next Steps

The next Renewable Energy Modeling Summit will on modeling issues, and will be held on February 12th. This meeting will start with a review of what questions we are trying to answer, to give the modelers more context for their discussions. Modelers will be asked to come up with a list of common, specific issues related to better capturing renewable energy in their models. The planning team will develop a draft list of these issues for discussion.

Results Summary

Introduction

Tom Kerr, EPA Energy Supply and Industry Branch, offered an introduction, explaining EPA's work on clean energy supply through voluntary partnerships with companies and organizations. Analysis using models that are capable of depicting renewable energy alternatives is important to this work, which is housed under EPA's Climate Protection Partnerships Division, as well as to the work of the Clean Air Markets Division on local and regional air pollutants. Therefore, the modeling and analysis to be discussed is an area of close cooperation between these two parts of EPA.

Tom outlined the goals of the Renewable Energy Modeling Summit: to facilitate dialogue and assist with changes in models as needed. While the structure is open to comment, EPA envisions several follow-on discussions with model users and developers to identify and implement changes, and a final re-convening of policy-makers.

Tom acknowledged the co-sponsorship of DOE, NREL, and ACRE for this event.

Skip Laitner, EPA-OAR energy modeling expert, moderated the meeting. Skip oriented the group with perspectives on the complex set of issues that policy makers must consider in developing optimal renewable energy policies. Policy makers turn to model results in order to better understand some of these issues, and especially seek quantification of the costs and benefits of the technologies. However, Skip pointed out that while costs are easily quantified in existing modeling frameworks, many of the benefits of renewable energy are less easily incorporated. Skip encouraged the group to think creatively about potential innovations in modeling that would allow models to better evaluate the great potential of new technologies.

Policy Makers' Perspectives

Greg Kats, ACRE, facilitated this session, and first introduced **Mike Eckhart**. Mike described the mission of ACRE: to bring renewable energy into mainstream. It is a non-governmental organization, not a trade association, and has set out to provide information, education, and outreach, drawing on all of the groups that are needed to get

the technologies used. Modeling and analysis are essential to advance the state of information about the potential for renewable energy.

Greg Kats noted the importance of calculating the overall value of renewable energy projects, especially to take into account values such as the distributed generation value to the electrical grid, or the total life-cycle value of green building construction. Such considerations may be neglected in competitive electricity markets and building markets where responsibility for design decisions and long term maintenance are separated. Good quantification of these values helps advance projects.

Brian McLean of EPA's Office of Atmospheric Programs described the reasons for EPA's interest in modeling of renewable energy. EPA seeks to promote renewable energy through cap and trade programs and through voluntary partnerships. EPA needs modeling to establish expectations and estimate results. Brian described the status and results of the renewable energy aspects of EPA's cap and trade and voluntary partnership programs. Ongoing and future analysis includes development of average displaced emissions rate methodology using the IPM model. This will be a robust methodology to estimate emissions benefits of displacing baseline grid electricity, and will be used in education and outreach. It is expected to be released this Fall. Detailed analysis of technology characterization is under way. EPA is also developing a forecast of green power market demand for GHG benefits analysis. Ongoing policy analysis includes assessment of the impacts of the Clear Skies Initiative, as Sasha Mackler will discuss.

Sam Baldwin, Chief Technology Officer, Office of Energy Efficiency and Renewable Energy, Department of Energy, presented an overview of the applications of renewable energy modeling in research design, research planning, research impacts analysis, portfolio analysis, and policy design. Highlights included the role of the expert judgement of modelers in shaping results; the high levels of uncertainty associated with future events, even with known markets and products; the benefits matrix developed by the National Academy of Sciences (NAS) and the National Research Council (NRC) and its potential to make model results useful to policy-makers; and the variety, temporal diversity, and complexity of issues that all need to be address through modeling. Sam emphasized modeling needs, including the need to estimate the options value and the value of distributed renewable energy, the need to perform detailed modeling that can capture regional impacts and include it in national models, and the need to depict all benefits of renewable energy. Approaches to improve modeling of renewable energy include the development of analytically detailed case studies, web-based opportunities for public scrutiny and user interaction, development of tools that are open, transparent, adjustable, collaborative, modular, systematic, and rigorous. Sam noted that policy-makers will opt for simplicity and transparency over potentially false precision.

Mark Kapner, Austin Energy, described Austin's green power program and the status of renewable energy policy in Texas. Austin's Green Choice provides dual benefits to customers: green power purchase and energy price hedge. Texas' renewable energy policy has allowed the cost of wind farm development to plummet because of long-term purchase contracts that lower the developer's risk.

John Darnell of Congressman Roscoe Bartlett's staff, offered a "front row seat perspective" as staff participating in the work of the Energy / Science Subcommittee,

which does not get involved in policy issues. John used the example of the 1970s energy crisis to illustrate that modeling can be effective only if you have the right assumptions, and that underlying circumstances can quickly change, with dramatic, unexpected effects. The underlying circumstance that changed was the peak and subsequent decline in the level of production from domestic oilfields. John pointed out that all energy resources except for sustainably managed renewable ones experience this same "Hubbard" curve in level of production. He suggested the importance finding a path to long-term sustainability and that modeling results can help trace that path backwards from a desirable future. However, he cautioned that Congress is not focused on the importance of long-term sustainability.

Jigar Shah, BP, identified the modeling analyses that are most useful in a commercial context. The value of distributed generation and the data that are used in financing and risk management decisions are crucial customer-oriented analytic results. A consideration of a commercial perspective highlights the importance of financial and market analysis, including such factors as insurance, financing with equity, debt, and subsidies, maintenance issues, customer service issues, and intangible factors such as green image. In general, reducing risks perceived by lenders and customers was seen as an overriding goal for analysis.

Users' Insights

Please refer to presentations and handouts for descriptions of each model. This section will focus on users' insights on strengths and weaknesses in addressing policy-makers' issues, not on model descriptions.

AMIGA (Don Hanson) has strengths in using learning curves to provide endogenous calculation of technology improvements. Don and the University of Michigan are developing statistical methods to characterize the intermittence of wind resources with respect to correlation of resource availability over a large geographic region, and these are being incorporated into AMIGA. This will allow for a more accurate estimate of the effect of intermittence on the grid. On the benefits side, AMIGA has been used to estimate regional economic impacts of renewable energy. The model is also well suited to estimate financing barriers to renewable energy use.

IPM (Sasha Mackler, EPA) has the advantage of representing fuel, electricity, and environmental markets together, allowing the application of emission constraints to the electric sector and modeling of strategies such as fuel switching and emission credit trading and banking. This allows for the possibility of modeling interactions among the markets that may lead to unexpected results. A potential weakness for modeling renewable electricity generation is that the renewable energy results do not change dramatically under different scenarios. This could reflect assumptions about limits on renewable generation that may merit further investigation to be sure that the limits can be overcome with sufficient incentive. Regarding issues of transparency and public review, IPM is extensively documented and model run results are routinely posted by EPA on the internet. The model itself is proprietary.

MARKAL (Phil Tseng, DOE) has a very flexible structure that can accommodate a variety of time horizons, demand specifications, and technologies. Its incorporation of consumer behavior, depending on the details, could be useful in addressing some of the

issues raised by Jigar Shah regarding consumer choices in the face of risk and financing challenges. MARKAL's integration of energy, economic, and environmental analysis can illuminate unexpected results from interactions among these sectors. MARKAL is in the public domain, and its large user community provides substantial technical resources. Phil identified areas for improvement, including the regional representation of the location of renewable resources, transmission line constraints, and investment costs, intermittence, and regional load curves.

NEMS (Steve Clemmer, UCS) is a comprehensive, integrated energy-economic model developed and maintained by the Energy Information Administration, which, as a public agency, is very responsive to model user requests. EIA provides extensive documentation of model algorithms and peer review of model assumptions. NEMS assumptions place a number of constraints on the development of renewable energy, and UCS finds some of these are overly conservative, with multiple constraints potentially having unintended results. In some cases, assumptions are made where it could be possible to model the results instead. UCS is in favor of ongoing review and updating of assumptions in NEMS; increasing the flexibility of the model structure to accommodate other assumptions; increasing the ability to model factors such as technology learning, variable output, transmission; as well as quantification of uncertainties.

MiniCAM / AGLU (Michael Leifmann, EPA) is different from the other models in that it has a global, long-term scope, incorporates agriculture, land use, and climate modeling, and focuses on emissions and economic cost resulting from alternative GHG abatement policies. Its weaknesses include the relatively broad regional and technology groupings and lack of ability to model detailed electricity sector behavior such as dispatch order by capacity and cost. The model is in the middle of a formal documentation and peer review process.

Model Developers' Perspectives

Tom Petersik, EIA, offered a model developer's perspective on NEMS. He highlighted that NEMS' strength is efficient decisions in central station markets and that it is less strong in environmental markets and national security. The model assumes a competitive electricity market on the planning side by using competitive independent power producer (IPP) costs for capacity planning, with the capacity planning module minimizing system cost rather than optimizing project-owner profit. Retail markets may be represented as either regulated or competitive retail markets, depending on the market structure of each State. NEMS uses a market sharing algorithm, so that technologies whose costs are within 20 percent of the least-cost alternative get some share of new capacity builds; as an upper bound, a higher-cost technology nearly identical to the least-cost alternative could garner nearly half of new capacity if it were the only higher-cost alternative. These attributes can help address some of the market issues that policy makers raised.

The approach to inter-regional transmission is a common issue among electric sector models with multiple regions, and a crucial issue for renewable energy because many renewable resources can not be transported to be closer to demand centers. In NEMS, there are limits on inter-regional trade based on historical evidence. Tom also pointed out that non-renewable inter-regional transmission could also be important.

NEMS incorporates a set of long-term cost multipliers that are intended to reflect three factors:

1) The degradation of the quality of renewable energy resources as the best sites are used;
2) The need to upgrade the transmission network as additional generation of any type is added;
3) Market factors.

Tom thought that the quantity of the effect of these factors is not well known, and should be studied; nevertheless, these factors do appear to have an effect.

NEMS may be used to model distributional effects of policies, such as the RPS, as well as the net costs, and this is valuable for policy makers.

NEMS is being updated to model the effect of increasing cost associated with incorporation of large amounts of intermittent resources, rather than applying an intermittency limit. This is an example of how an assumption is being replaced with calculations.

Tom highlighted several additional improvements that are under way, including upgrading wind and geothermal data.

As a point of clarification to the least-cost issue, Susan Holte noted that the transportation demand sector of NEMS is not a least- cost model, but rather that vehicle choice is modeled with multiple attributes, cost being one of many that are considered. Such an approach could possibly be extended to other markets to capture technology attributes other than cost.

Gary Goldstein offered a model developer's perspective on MARKAL. It is being used to build the SAGE model for international applications in EIA. This allows the model to run myopically, with endogenous technology learning. Gary noted that the model needs guidance from policy discussions. He also pointed out that MARKAL documentation has been limited, and the SAGE project is going to develop good documentation for parts of the model, with ETSAP producing the rest of the documentation. In addition, he noted that MARKAL can use uncertainty, learning for technology costs, and has been run in goal-directed variants.

Mike Eckhart provided a comment for further discussion: that society wants to pay for environmental benefits, and that least cost planning is out of touch with this demand for green power. ACRE wants to see market behavior models that take into account willingness to pay for environmental benefits.

Discussion

Tom Kerr kicked off the discussion with a suggestion of January – February as a possible time frame for a second meeting.

Bruce Biwald suggested that another type of model in the electricity sector – detailed simulation models of specific control areas – could inform the present discussion by

actual modeling of issues such as intermittence and transmission, as well as unit commitment, rules, bidding rules, strategic behavior, non- marginal cost bidding.

Skip Laitner commented on the importance of creating and modeling markets that account for the full set of benefits of solar energy.

Jigar Shah noted that values may be highest for renewable electricity in rural coops, and other niche markets, but NEMS doesn't model these as well as other markets. He also noted the need for market research data for models.

Chris Namovicz noted that NEMS can value a green market, but that EIA must base its market mechanisms on market structures that are observed, and does not assume new market mechanisms in order to place value on renewable electricity externalities.

Bishal Thapa noted the need to distinguish model vs. data: most models can be applied to many different situations, but data are often the limitation. He cautioned that it's possible to get refinement without getting better accuracy, so the concern is not just model development but data development. In addition, he noted that there were modeling issues associated with how to handle unique features of technologies, and such frameworks, once developed, could be applied to many different situations.

Michael Shelby suggested that we might wish to look at how the different models handle a specific set of scenarios, in an EMF-like exercise, to try to explore the impacts of specific policy issues.

Building on this suggestion, Skip asked if the group could look at a specific policy issue, using a standard set of assumptions, and answer specific questions about the model results and the reasons for those results.

Gary Goldstein described an APEC study that is just completing a similar exercise in a 5 country region. The organizers asked for modelers to estimate the penetration of renewable energy, using a standard set of inputs, and a standard set of output tables. Gary offered to make these results available these results.

Walter Short questioned whether the group should try to run all the models with the same data, noting the need to deal with structural issues of the models for representing intermittence and transmission. A concern about this type of exercise is that it would be tempting to assume that where the models agree everything is fine, but in fact the common methodology and assumptions used among models means that they frequently err together.

Maggie Mann voiced support for the idea of doing some sort of comparison across the models to establish a clearer understanding of the similarities and differences among them.

Eldon Boes raised the question of whether or not we should strive for one model that can do everything, and wondered if that was the purpose of the comparison. He also suggested a focus on, "What are the big issues?" and suggested that fossil fuel cost uncertainty and willingness to pay for the full set of renewable energy benefits were priorities.

Susan Holte was not in favor of a comparative, EMF-type exercise, thinking that effort would be better spent on examining specific modeling issues. She suggested that major issues include modeling benefits, especially environmental benefits and market benefits. She also noted that the EMF is now studying natural gas markets and the impact of renewable energy on the supply and technology aspects of natural gas. She suggested that the hedge value against natural gas price volatility is only relevant to short-term models.

Walter Short raised the question of how to quantify consumer preferences, especially given that consumer preferences change over time.

Greg Kats noted volatility is also a national security issue, and said that overall vulnerability of the energy system, as will as health, environmental benefits, reliability, line losses, are all difficult to quantify but should be approximated. Further, he cited evidence of the importance of consumer preference, including the widespread use of the standards established by the Leadership in Energy & Environmental Design Green Building Rating System and of Green Power Purchases.

Tom Petersik noted that modelers face great challenges in representing alternatives that have highly uncertain prices, and in representing markets that are driven by state and federal policy, currently exogenous to the models. He also suggested that policies frequently reflect many of the benefits, and thus it is worth careful consideration whether each of the benefits should be accounted for endogenously, within the model.

Some final thoughts from a number of speakers on “where we go from here:”

-Focus on data, algorithm, or both?
-What can models do and what are the limitations?
-We should identify high priorities for collection of new data.
-What are the needs for policy analysis, as opposed to market analysis?
-What are the environmental benefits?
-Common model runs would be meaningless because of the different scope of models.
-What is the list of crucial issues, and what steps do you take to address those in the models?